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M. Boucadair
France Telecom
S. Venaas
Cisco
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# Updates to the IPv6 Multicast Addressing Architecture
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Abstract

This document updates the IPv6 multicast addressing architecture by defining the 17-20 reserved bits as generic flag bits. The document provides also some clarifications related to the use of these flag bits.

This document updates RFC 3956, RFC 3306 and RFC 4291.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

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## 1. Introduction

This document updates the IPv6 multicast addressing architecture [RFC4291] by defining the 17-20 reserved bits as generic flag bits (Section 2). The document provides also some clarifications related to the use of these flag bits (Section 3).

This document updates [RFC3956], [RFC3306], and [RFC4291]. These updates are logical consequences of the recommendation on the flag bits (Section 3).

Textual representation of IPv6 addresses included in the RFC updates follows the recommendation in [RFC5952].

## 2. Addressing Architecture Update

Bits 17-20 of a multicast address are defined in [RFC3956] and [RFC3306] as reserved bits. This document defines these bits as generic flag bits so that they apply to any multicast address. Figure 1 and Figure 2 show the updated structure of the addressing architecture. The first diagram shows the update of the base IPv6 addressing architecture, and the second shows the update of so-called Embedded-RP.

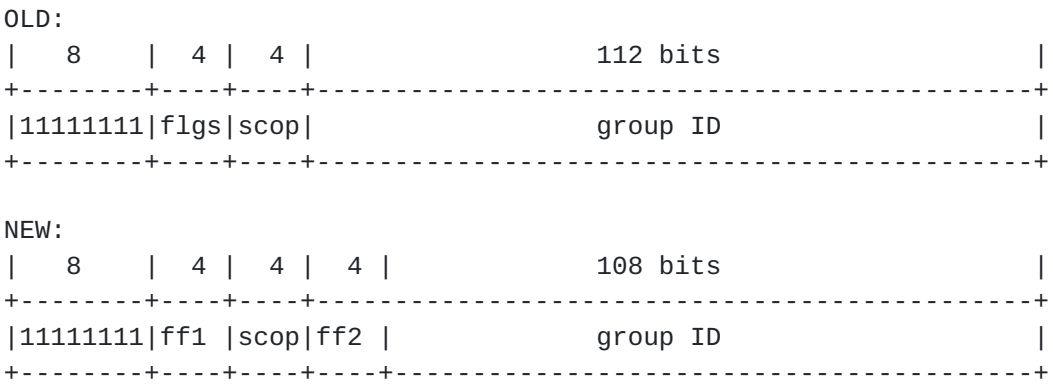



Figure 1: Updated IPv6 Multicast Addressing Architecture

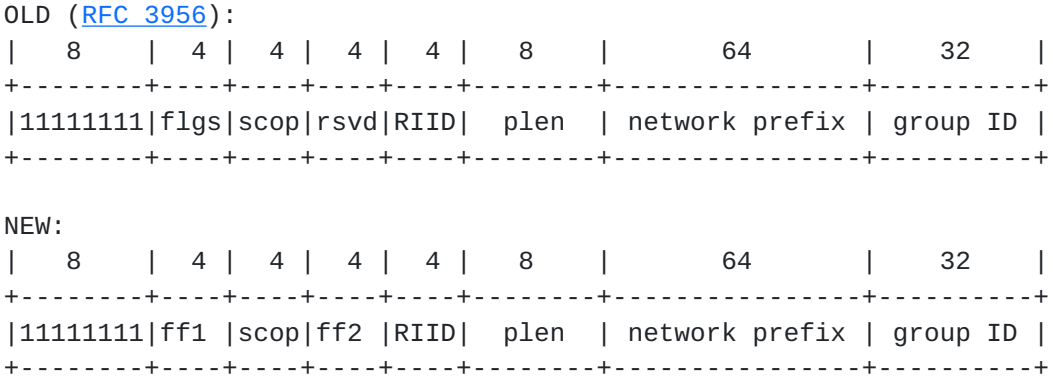



Figure 2: Embedded-RP with Updated IPv6 Multicast Address Arch.

Further specification documents may define a meaning for these flag bits. Defining the bits 17-20 as flags for all IPv6 multicast addresses allows addresses to be treated in a more uniform and generic way, and allows for these bits to be defined in the future for different purposes, irrespective of the specific type of multicast address.

## 3. Flag Bits: A Recommendation

Some implementations and specification documents do not treat the flag bits as separate bits but tend to use their combined value as a 4-bit integer. This practice is a hurdle for assigning a meaning to the remaining flag bits. Below are listed some examples for illustration purposes:

- the reading of [RFC3306] may lead to conclude that ff3x::/32 is the only allowed SSM IPv6 prefix block.

- [RFC3956] states only ff70::/12 applies to Embedded-RP. Particularly, implementations should not treat the fff0::/12 range as Embedded-RP.

To avoid such confusion and to unambiguously associate a meaning with the remaining flags, the following requirement is made

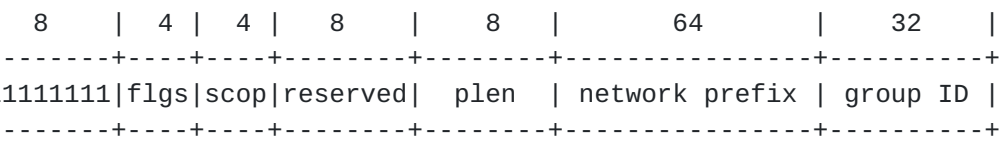
> Implementations MUST treat flag bits as separate bits.

## 4. RFC Updates

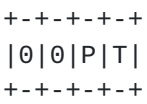
### 4.1. RFC 3306

This document changes Section 4 of [RFC3306] as follows:

OLD:




flgs is a set of 4 flags:



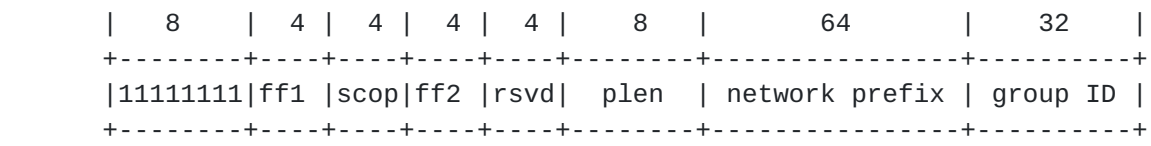

- P = 0 indicates a multicast address that is not assigned based on the network prefix. This indicates a multicast address as defined in [ADDRARCH].

- P = 1 indicates a multicast address that is assigned based on the network prefix.

- If P = 1, T MUST be set to 1, otherwise the setting of the T bit is defined in Section 2.7 of [ADDRARCH].

The reserved field MUST be zero.

NEW:




ff1 (flag field 1) is a set of 4 flags:




X and Y may each be set to 0 or 1.

- P = 0 indicates a multicast address that is not assigned based on the network prefix. This indicates a multicast address as defined in [RFC4291].

- P = 1 indicates a multicast address that is assigned based on the network prefix.

- If P = 1, T MUST be set to 1, otherwise the setting of the T bit is defined in Section 2.7 of [RFC4291].

ff2 (flag field 2) is a set of 4 flags:




where "rrrr" are for future assignment as additional flag bits.

Flag bits denote both ff1 and ff2.

This document changes Section 6 of [RFC3306] as follows:

OLD:

> These settings create an SSM range of FF3x::/32 (where 'x' is any valid scope value). The source address field in the IPv6 header identifies the owner of the multicast address.

NEW:

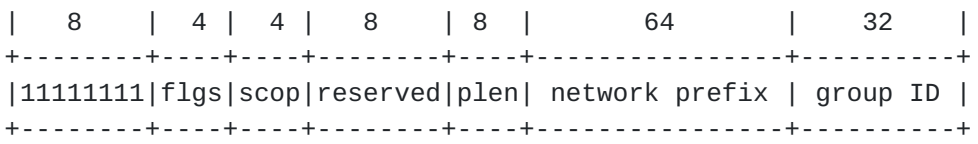
> If the flag bits in ff1 are set to 0011, these settings create an SSM range of ff3x::/32 (where 'x' is any valid scope value). The source address field in the IPv6 header identifies the owner of the multicast address. ff3x::/32 is not the only allowed SSM prefix range. For example if the most significant flag bit in ff1 is set, then we would get the SSM range ffbx::/32.

## 4.2. RFC 3956

This document changes Section 2 of [RFC3956] as follows:

OLD:

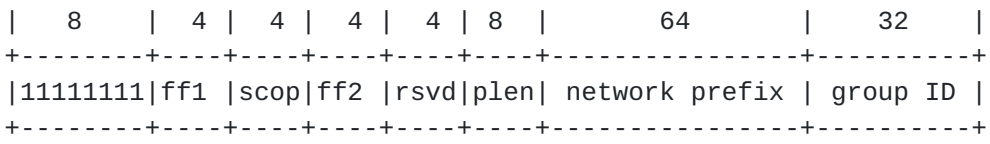
As described in [RFC3306], the multicast address format is as follows:




Where flgs are "0011". (The first two bits are as yet undefined, sent as zero and ignored on receipt.)

NEW:

The multicast address format is as follows:

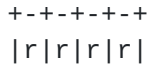



ff1 (flag field 1) is a set of four flags:




X may be set to 0 or 1.

ff2 (flag field 2) is a set of 4 flags:

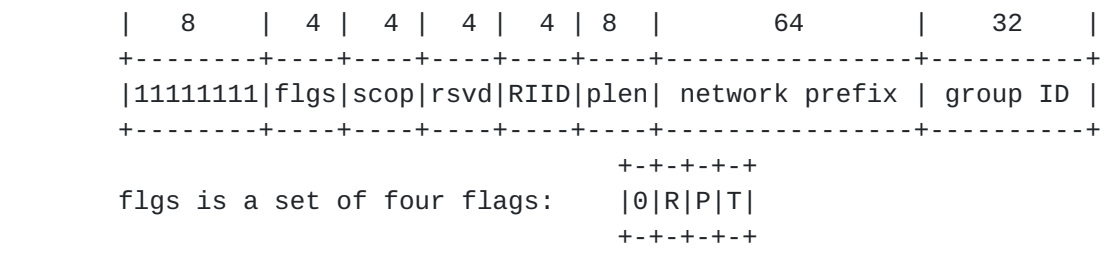



where "rrrr" are for future assignment as additional flag bits.

Flag bits denote both ff1 and ff2.

This document changes Section 3 of [RFC3956] as follows:

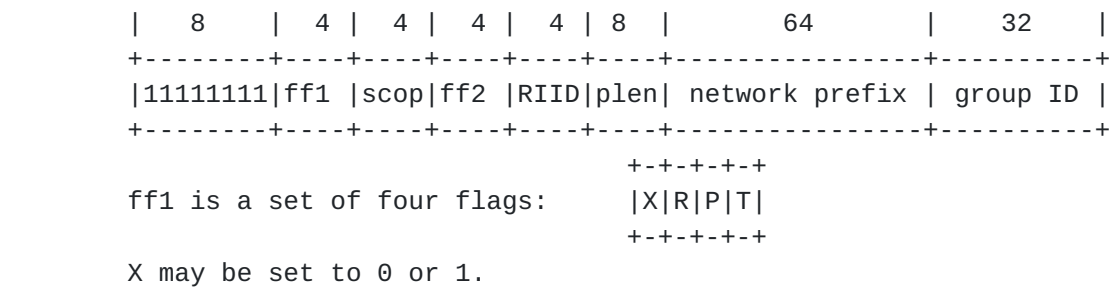
OLD:




When the highest-order bit is 0, R = 1 indicates a multicast address that embeds the address on the RP. Then P MUST be set to 1, and consequently T MUST be set to 1, as specified in [RFC3306]. In effect, this implies the prefix FF70::/12. In this case, the last 4 bits of the previously reserved field are interpreted as embedding the RP interface ID, as specified in this memo.

The behavior is unspecified if P or T is not set to 1, as then the prefix would not be FF70::/12. Likewise, the encoding and the protocol mode used when the two high-order bits in "flgs" are set to 11 ("FFF0::/12") is intentionally unspecified until such time that the highest-order bit is defined. Without further IETF specification, implementations SHOULD NOT treat the FFF0::/12 range as Embedded-RP.

NEW:




X may be set to 0 or 1.

R = 1 indicates a multicast address that embeds the address of the RP. P MUST be set to 1, and consequently T MUST be set to 1, according to [RFC3306], as this is a special case of unicast-prefix based addresses. This implies that for instance prefixes ff70::/12 and fff0::/12 are embedded RP prefixes.
The behavior is unspecified if P or T is not set to 1. When the R-bit is set, the last 4 bits of the previously reserved field are interpreted as embedding the RP interface ID, as specified in this memo.

This document changes Section 4 of [RFC3956] as follows:

OLD:

It MUST be a multicast address with "flgs" set to 0111, that is, to be of the prefix FF70::/12,

NEW:

It MUST be a multicast address with R-bit set to 1.

It MUST have P-bit and T-bit both set to 1 when using the embedding in this document as it is a prefix-based address.

This document changes Section 7.1 of [RFC3956] as follows:

OLD:

To avoid loops and inconsistencies, for addresses in the range FF70::/12, the Embedded-RP mapping MUST be considered the longest possible match and higher priority than any other mechanism.

NEW:

To avoid loops and inconsistencies, for addresses with R-bit set to 1, the Embedded-RP mapping MUST be considered the longest possible match and higher priority than any other mechanism.

## 5. IANA Considerations

This document does not require any action from IANA.

## 6. Security Considerations

Security considerations discussed in [RFC3956], [RFC3306] and [RFC4291] MUST be taken into account.

## 7. Acknowledgements

Special thanks to B. Haberman for the discussions prior to the publication of this document.

Many thanks to J. Korhonen and T. Jinmei their comments.

## 8. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC3306] Haberman, B. and D. Thaler, "Unicast-Prefix-based IPv6 Multicast Addresses", RFC 3306, August 2002.

[RFC3956] Savola, P. and B. Haberman, "Embedding the Rendezvous Point (RP) Address in an IPv6 Multicast Address", RFC 3956, November 2004.

[RFC4291] Hinden, R. and S. Deering, "IP Version 6 Addressing Architecture", RFC 4291, February 2006.

[RFC5952] Kawamura, S. and M. Kawashima, "A Recommendation for IPv6 Address Text Representation", RFC 5952, August 2010.

## Authors' Addresses

Mohamed Boucadair
France Telecom
Rennes 35000
France

Email: mohamed.boucadair@orange.com

Stig Venaas
Cisco
USA

Email: stig@cisco.com